PATENT ABSTRACTS OF JAPAN

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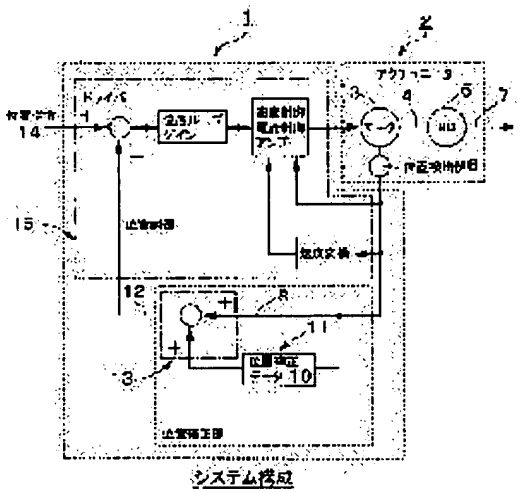
KANAYAMA NAOKI

(54) METHOD FOR CORRECTING POSITIONING ERROR OF ACTUATOR

(57)Abstract:

PROBLEM TO BE SOLVED: To improve the positioning accuracy of an actuator having a wave reduction gear.

SOLUTION: In the drive control device 1 for the actuator, a positioning error of the actuator 2 is measured for one rotation of the output shaft 7 of the wave reduction gear 5 based on the absolute position of a motor rotating shaft 4 and this measured error data are averaged, error correction data 10 indicating an error correction value with respect to each rotating position for one rotation of the motor rotating shaft are stored in the error correction data storage portion 11 of the drive control device. During drive control, the rotating position of the motor rotating shaft 4 is detected and the error correction value allocated to the rotating position in the error correction data 10 is added to the detected rotating position information 8 to create rotating position correction information 12, which is then used as position feedback information for controlling the positioning of an actuator output shaft 7.



システム構成

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CLAIMS

[Claim(s)]
[Claim 1] The locational error amendment approach of a motor revolving shaft's one revolution of the locational error of the output shaft in the actuator equipped with the wave-motion gear reducer which slows down a motor and motor output rotation and is transmitted to a load side absolutely amended based on a location.
[Claim 2] In claim 1 the locational error of said actuator by [of one revolution of a motor revolving shaft] measuring based on a location absolutely As opposed to the rotation positional information which creates error correction data, detected the rotation location of said motor revolving shaft, and was detected The error correction value currently assigned to the rotation location concerned in said error correction data is added. The locational error amendment approach of the actuator characterized by creating rotation location amendment information and using the created rotation location amendment information as position feedback information for carrying out point to point control of said output shaft.
[Claim 3] The locational error amendment approach of the actuator characterized by the thing of a motor revolving shaft's one revolution of the locational error of said actuator for which said output shaft measures by one revolution at least based on a location absolutely, and error correction data are created in claim 2.
[Claim 4] The locational error amendment approach of the actuator characterized by averaging the error data of a motor revolving shaft's one revolution of the locational error of said actuator which said output shaft measured a part made one revolution at least based on the location absolutely, and were measured, and creating the error correction data showing the error correction value over each rotation location for said one motor revolving-shaft revolution in claim 2.
[Claim 5] The error correction data storage section with which are the drive control device of the actuator which amends a locational error by the approach according to claim 1, and said error correction data are remembered to be, The rotation positional information supplied from the position transducer of said motor revolving shaft which detects a location absolutely, and the rotation location amendment information creation section which creates said rotation location amendment information based on said error correction data, The drive control unit of the actuator characterized by having the feedback control section which carries out feedback control of said actuator by making said created rotation location amendment information into position feedback information so that it may become the target position shown using location command information.
[Claim 6] It is the drive control unit of the actuator which storage maintenance of said error correction data is carried out in claim 5 at said position transducer, and is characterized by downloading from this position transducer after powering on at said error correction data storage section.
[Claim 7] It is the drive control unit of the actuator characterized by being either the data stream of the amendment pulse as error correction information [in / on claims 5 or 6 and / in said error correction data / each rotation location for said one motor revolving-shaft revolution] or the multiplier trains of the approximate expression showing the error in each rotation location for said one motor revolving-shaft revolution.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the drive control unit of the actuator which performs positioning actuation by the locational error amendment approach and the amendment approach concerned of the actuator equipped with the wave-motion gear reducer.
[0002]
[Description of the Prior Art] The thing of a configuration of slowing down motor output rotation with a wave-motion gear reducer, and moving the member by the side of a load to a target position as an actuator, is known. The wave-motion gear reducer is equipped with the annular rigid internal gear, the annular flexible external-tooth gearing, and the wave-motion generator.
[0003] With a typical configuration, a flexible external-tooth gearing is ****(ed) by the ellipse form by the wave-motion generator, if the external-tooth part located in the both ends of the direction of an ellipse form major axis is clenched by the internal-tooth part to which a rigid internal gear corresponds and this wave-motion generator is rotated by the motor, both gearings' engagement position will move to a circumferencial direction, and the relative rotation according to both gearings' number-of-teeth difference will occur on both the gearings concerned. Generally a rigid internal gear is fixed, a flexible external-tooth gearing rotates as a moderation rotation output element, and the rotation drive of the member by the side of the load connected with the flexible external-tooth gearing concerned is carried out at a low speed.
[0004] Generally the drive control device of the actuator of this configuration is performing point-to-point control of an actuator by feedback control.
[0005]
[The technical problem which invention will solve and to carry out] Here, there is an angular transmission error in a wave-motion gear reducer, and an error occurs according to this error between the actual positioning location by the actuator output shaft (output shaft of a wave-motion gear reducer), and a target positioning location. If this error can be compensated, the positioning accuracy of the actuator equipped with the wave-motion gear reducer can be raised.
[0006] Then, the technical problem of this invention is in the drive control device of the actuator equipped with the wave-motion gear reducer by adding the location amendment function for amending the locational error which originates in the feedback control loop of the position control at the angular transmission error of a wave-motion gear reducer to improve the positioning accuracy of the drive control device concerned.
[0007]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the locational error amendment approach of this invention is characterized by the thing of a motor revolving shaft's one revolution of the locational error of the output shaft in the actuator equipped with the wave-motion gear reducer which slows down a motor and motor output rotation and is transmitted to a load side absolutely amended based on a location.

[0008] The locational error of said actuator here by [of one revolution of a motor revolving shaft] measuring based on a location absolutely As opposed to the rotation positional information which creates error correction data, detected the rotation location of said motor revolving shaft, and was detected The error correction value currently assigned to the rotation location concerned in said error correction data is added, rotation location amendment information can be created and the created rotation location amendment information can be used as position feedback information for carrying out point to point control of said output shaft.
[0009] In this case, when [of a motor revolving shaft's one revolution of the locational error of said actuator] said output shaft measures by one revolution at least based on a location absolutely, error correction data can be created.
[0010] Moreover, the error data of a motor revolving shaft's one revolution of the locational error of said actuator which said output shaft measured a part made one revolution at least based on the location absolutely, and were measured can be averaged, and the error correction data showing the error correction value over each rotation location for said one motor revolving-shaft revolution can be created.

[0011] Next, this invention The error correction data storage section with which are the drive control device of the actuator which amends a locational error by this approach, and the :aforementioned error correction data are remembered to be; It is based on the rotation positional information supplied from the position transducer of said motor revolving shaft which detects a location absolutely, and said error correction data. The rotation location amendment information creation section which creates said rotation location amendment information; Said created rotation location amendment information is made into position feedback information. It is characterized by having the feedback control section which carries out feedback control of said actuator so that it may become the target position shown using location command information.
[0012] Here, storage maintenance of said error correction data is carried out at said position transducer, and you may constitute so that it may download from this position transducer after powering on at said error correction data storage section. If it does in this way, wide use of a drive control unit can be attained.
[0013] Moreover, said error correction data can be made into the data stream of the amendment pulse as error correction information in each rotation location for said one motor revolving-shaft revolution. It can also consider as the multiplier train of the approximate expression which instead expresses the error in each rotation location for said one motor revolving-shaft revolution.
[0014]
[Embodiment of the Invention] An example of the drive control unit of the actuator which applied this invention to below with reference to the drawing is explained.
[0015] Drawing 1 is the outline block diagram showing the drive control unit of the actuator of this example. this -- a drive -- a control device -- one -- driving -- having -- a book -- an example -- an actuator -- two -- a motor -- three -- this -- a motor -- a revolving shaft -- four -- connecting -- having had -- the wave motion -- a gear reducer -- (-- HD --) -- five -- a motor -- a revolving shaft -- four -- absolute rotation -- a location -- detection -- being possible -- a position transducer -- six -- having -- **** . It is connected with the load (not shown), the output shaft 7, i.e., the actuator output shaft, of the wave-motion gear reducer 5. Position transducers 6 are position transducers which can detect a location absolutely, such as a rotary encoder and a potentiometer.
[0016] The drive control unit 1 which controls the drive of an actuator 2 The error correction data storage section 11 the error correction data 10 for compensating the locational error resulting from the angular transmission error of the wave-motion gear reducer 5 are remembered to be, The rotation positional information 8 supplied from a position transducer 6, and the rotation location amendment information creation section 13 which creates the rotation location amendment information 12 based on the error correction data 10, It has the feedback control section 15 which carries out feedback control of the actuator 2 by making created rotation location amendment information 12 into position feedback information so that it may become the target position shown using the location command information

14. The above-mentioned rotation location amendment information creation section 13 can be used as an adder or a subtractor.

[0017] (Error correction data) Here, the error correction data 10 of this example are created as follows. First, the locational error of the motor revolving shaft 4 in an actuator 2 is compressed into 1 for a reduction gear ratio of the reducer concerned by moderation of the wave-motion gear reducer 5 with which this is connected. For example, when the ** ratio of the wave-motion gear reducer 5 is 50 or 100, the locational error of the motor itself is compressed into 1/50 or 1/100. Therefore, since the locational error of an actuator 2 originates mainly in the angular transmission error of the wave-motion gear reducer 5, the unidirectional-approach precision of the actuator 2 concerned will be decided by the angular transmission error of the wave-motion gear reducer 5.

[0018] Unidirectional-approach precision positions one after another in the hand of cut of the fixed direction, and is each location, the difference of the include angle actually rotated from the criteria location and the include angle which should be rotated is searched for, and the maximum under 1 rotation of these values is expressed.

[0019] In this example, the locational error of the unidirectional-approach precision of an actuator 2, i.e., an actuator, is measured a part of the actuator output shaft 7 made one revolution based on the absolute location of the motor revolving shaft 4. For example, when the ** ratio of the wave-motion gear reducer 5 is 1/50 and the motor revolving shaft 4 rotates 50 times, an output shaft 7 will make one revolution.

[0020] As shown in drawing 2 , this locational error is measured based on the output of a position transducer 6, whenever 3 degrees of motor revolving shafts 5 rotate. In this case, a measure point is 120 points (360 degrees / 3 degrees) about the motor revolving shaft 5, and becomes a part for 120 point x (** ratio) in the actuator output shaft 7.

[0021] In addition, instead of unidirectional-approach precision, even if the include-angle intermediary precision of a wave-motion gear reducer is used for the data to measure, they are substantially the same. Moreover, as for measurement, it is needless to say that it may continue not only a part of an output shaft 7 made one revolution but more than one revolution, and you may measure.

[0022] Next, as shown in the lowest line in the table of drawing 2 , the error data of each measure point, for example, 120 error data, are equalized, respectively, and the error correction data 10 of the motor revolving shaft 4 made one revolution are created.

[0023] The format of the created error correction data 10 can be made into the amendment pulse number for error correction to each angle-of-rotation location in a part of the motor revolving shaft 4 made one revolution. For example, as shown in drawing 3 , the number of amendment Hals measured every 3 degrees as mentioned above can be used as the correspondence table assigned to the rotation location in every 3 degrees of the motor revolving shaft 4.

[0024] Instead the fourier expansion into series of the error correction data of the motor revolving shaft 4 made one revolution is carried out, and it asks for an approximation curve, and may be made to carry out storage maintenance by using each multiplier of the Fourier series showing the approximation curve concerned as the error correction data 10. In this case, what is necessary is to compute amendment data by applying the multiplier which is carrying out storage maintenance to an approximate expression, and just to create the data stream of an amendment pulse as shown in drawing 3 in the initialization processing after turning on the drive power source of the drive control unit 1.

[0025] (Locational error amendment actuation) Next, amendment of the locational error which is the description part of the drive control action of the actuator 2 by the drive control device 1 is explained. It asks for the amendment pulse number of the motor revolving shaft 4 expressed by the feedback pulse concerned which corresponds from the error correction data 10 absolutely based on a location, the amendment pulse number is added to a feedback pulse (8) in the rotation location amendment information creation section 13, and it returns to the feedback pulse (8) of the location detection from a position transducer 6 by making an addition result into a location feedback pulse (12) at the feedback-control section 15. In the feedback control section 15, based on the location feedback pulse (12) concerned, feedback control of the actuator 2 is carried out so that it may become the target position directed using the location command information 14 that it is inputted.

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[0026] In addition, in this example, it is made to carry out storage maintenance of the error correction data 10 at the drive control unit 1. You may make it make the position transducer 6 of an actuator 2 instead carry out storage maintenance of the error correction data 10. In this case, what is necessary is just to constitute in initialization processing immediately after supplying a power source to the drive control device 1, so that the error correction data 10 currently held at the position transducer 6 of an actuator may be downloaded to the drive control-device 1 side.
[0027]
[Effect of the Invention] The locational error resulting from the angular transmission error of a wave-motion gear reducer is measured beforehand, and the error-correction data which can amend the locational error in each rotation location of a motor revolving shaft are created, and he calculates the error correction value of the rotation location which corresponds from error correction data absolutely based on a location of a motor revolving shaft, and he is trying to amend position feedback information in the locational error amendment approach of the actuator of this invention at the time of actual error correction, as explained above. Therefore, according to this invention, the positioning accuracy of the actuator equipped with the wave-motion gear reducer is improvable.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the drive control unit of the actuator which performs positioning actuation by the locational error amendment approach and the amendment approach concerned of the actuator equipped with the wave-motion gear reducer.

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PRIOR ART

[Description of the Prior Art] The thing of a configuration of slowing down motor output rotation with a wave-motion gear reducer, and moving the member by the side of a load to a target position as an actuator, is known. The wave-motion gear reducer is equipped with the annular rigid internal gear, the annular flexible external-tooth gearing, and the wave-motion generator.
[0003] With a typical configuration, a flexible external-tooth gearing is ****(ed) by the ellipse form by the wave-motion generator, if the external-tooth part located in the both ends of the direction of an ellipse form major axis is clenched by the internal-tooth part to which a rigid internal gear corresponds and this wave-motion generator is rotated by the motor, both gearings' engagement position will move to a circumferencial direction, and the relative rotation according to both gearings' number-of-teeth difference will occur on both the gearings concerned. Generally a rigid internal gear is fixed, a flexible external-tooth gearing rotates as a moderation rotation output element, and the rotation drive of the member by the side of the load connected with the flexible external-tooth gearing concerned is carried out at a low speed.
[0004] Generally the drive control device of the actuator of this configuration is performing point-to-point control of an actuator by feedback control.

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EFFECT OF THE INVENTION

[Effect of the Invention] The locational error resulting from the angular transmission error of a wave-motion gear reducer is measured beforehand, and the error-correction data which can amend the locational error in each rotation location of a motor revolving shaft are created, and he calculates the error correction value of the rotation location which corresponds from error correction data absolutely based on a location of a motor revolving shaft, and he is trying to amend position feedback information in the locational error amendment approach of the actuator of this invention at the time of actual error correction, as explained above. Therefore, according to this invention, the positioning accuracy of the actuator equipped with the wave-motion gear reducer is improvable.

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TECHNICAL PROBLEM

[The technical problem which invention will solve and to carry out] Here, there is an angular transmission error in a wave-motion gear reducer, and an error occurs according to this error between the actual positioning location by the actuator output shaft (output shaft of a wave-motion gear reducer), and a target positioning location. If this error can be compensated, the positioning accuracy of the actuator equipped with the wave-motion gear reducer can be raised.
[0006] Then, the technical problem of this invention is in the drive control device of the actuator equipped with the wave-motion gear reducer by adding the location amendment function for amending the locational error which originates in the feedback control loop of the position control at the angular transmission error of a wave-motion gear reducer to improve the positioning accuracy of the drive control device concerned.

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MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the locational error amendment approach of this invention is characterized by the thing of a motor revolving shaft's one revolution of the locational error of the output shaft in the actuator equipped with the wave-motion gear reducer which slows down a motor and motor output rotation and is transmitted to a load side absolutely amended based on a location.
[0008] The locational error of said actuator here by [of one revolution of a motor revolving shaft] measuring based on a location absolutely As opposed to the rotation positional information which creates error correction data, detected the rotation location of said motor revolving shaft, and was detected The error correction value currently assigned to the rotation location concerned in said error correction data is added, rotation location amendment information can be created and the created rotation location amendment information can be used as position feedback information for carrying out point to point control of said output shaft.
[0009] In this case, when [of a motor revolving shaft's one revolution of the locational error of said actuator] said output shaft measures by one revolution at least based on a location absolutely, error correction data can be created.
[0010] Moreover, the error data of a motor revolving shaft's one revolution of the locational error of said actuator which said output shaft measured a part made one revolution at least based on the location absolutely, and were measured can be averaged, and the error correction data showing the error correction value over each rotation location for said one motor revolving-shaft revolution can be created.

[0011] Next, this invention The error correction data storage section with which are the drive control device of the actuator which amends a locational error by this approach, and the :aforementioned error correction data are remembered to be; It is based on the rotation positional information supplied from the position transducer of said motor revolving shaft which detects a location absolutely, and said error correction data. The rotation location amendment information creation section which creates said rotation location amendment information; Said created rotation location amendment information is made into position feedback information. It is characterized by having the feedback control section which carries out feedback control of said actuator so that it may become the target position shown using location command information.
[0012] Here, storage maintenance of said error correction data is carried out at said position transducer, and you may constitute so that it may download from this position transducer after powering on at said error correction data storage section. If it does in this way, wide use of a drive control unit can be attained.
[0013] Moreover, said error correction data can be made into the data stream of the amendment pulse as error correction information in each rotation location for said one motor revolving-shaft revolution. It can also consider as the multiplier train of the approximate expression which instead expresses the error in each rotation location for said one motor revolving-shaft revolution.
[0014]

[Embodiment of the Invention] An example of the drive control unit of the actuator which applied this invention to below with reference to the drawing is explained.
[0015] Drawing 1 is the outline block diagram showing the drive control unit of the actuator of this example. this -- a drive -- a control device -- one -- driving -- having -- a book -- an example -- an actuator -- two -- a motor -- three -- this -- a motor -- a revolving shaft -- four -- connecting -- having had -- the wave motion -- a gear reducer -- (-- HD --) -- five -- a motor -- a revolving shaft -- four -- absolute rotation -- a location -- detection -- being possible -- a position transducer -- six -- having -- **** . It is connected with the load (not shown), the output shaft 7, i.e., the actuator output shaft, of the wave-motion gear reducer 5. Position transducers 6 are position transducers which can detect a location absolutely, such as a rotary encoder and a potentiometer.
[0016] The drive control unit 1 which controls the drive of an actuator 2 The error correction data storage section 11 the error correction data 10 for compensating the locational error resulting from the angular transmission error of the wave-motion gear reducer 5 are remembered to be, The rotation positional information 8 supplied from a position transducer 6, and the rotation location amendment information creation section 13 which creates the rotation location amendment information 12 based on the error correction data 10, It has the feedback control section 15 which carries out feedback control of the actuator 2 by making created rotation location amendment information 12 into position feedback information so that it may become the target position shown using the location command information 14. The above-mentioned rotation location amendment information creation section 13 can be used as an adder or a subtractor.
[0017] (Error correction data) Here, the error correction data 10 of this example are created as follows. First, the locational error of the motor revolving shaft 4 in an actuator 2 is compressed into 1 for a reduction gear ratio of the reducer concerned by moderation of the wave-motion gear reducer 5 with which this is connected. For example, when the ** ratio of the wave-motion gear reducer 5 is 50 or 100, the locational error of the motor itself is compressed into 1/50 or 1/100. Therefore, since the locational error of an actuator 2 originates mainly in the angular transmission error of the wave-motion gear reducer 5, the unidirectional-approach precision of the actuator 2 concerned will be decided by the angular transmission error of the wave-motion gear reducer 5.
[0018] Unidirectional-approach precision positions one after another in the hand of cut of the fixed direction, and is each location, the difference of the include angle actually rotated from the criteria location and the include angle which should be rotated is searched for, and the maximum under 1 rotation of these values is expressed.
[0019] In this example, the locational error of the unidirectional-approach precision of an actuator 2, i.e., an actuator, is measured a part of the actuator output shaft 7 made one revolution based on the absolute location of the motor revolving shaft 4. For example, when the ** ratio of the wave-motion gear reducer 5 is 1/50 and the motor revolving shaft 4 rotates 50 times, an output shaft 7 will make one revolution.
[0020] As shown in drawing 2 , this locational error is measured based on the output of a position transducer 6, whenever 3 degrees of motor revolving shafts 5 rotate. In this case, a measure point is 120 points (360 degrees / 3 degrees) about the motor revolving shaft 5, and becomes a part for 120 point x (** ratio) in the actuator output shaft 7.
[0021] In addition, instead of unidirectional-approach precision, even if the include-angle intermediary precision of a wave-motion gear reducer is used for the data to measure, they are substantially the same. Moreover, as for measurement, it is needless to say that it may continue not only a part of an output shaft 7 made one revolution but more than one revolution, and you may measure.
[0022] Next, as shown in the lowest line in the table of drawing 2 , the error data of each measure point, for example, 120 error data, are equalized, respectively, and the error correction data 10 of the motor revolving shaft 4 made one revolution are created.
[0023] The format of the created error correction data 10 can be made into the amendment pulse number for error correction to each angle-of-rotation location in a part of the motor revolving shaft 4 made one revolution. For example, as shown in drawing 3 , the number of amendment Hals measured every 3 degrees as mentioned above can be used as the correspondence table assigned to the rotation location in

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every 3 degrees of the motor revolving shaft 4.
[0024] Instead the fourier expansion into series of the error correction data of the motor revolving shaft 4 made one revolution is carried out, and it asks for an approximation curve, and may be made to carry out storage maintenance by using each multiplier of the Fourier series showing the approximation curve concerned as the error correction data 10. In this case, what is necessary is to compute amendment data by applying the multiplier which is carrying out storage maintenance to an approximate expression, and just to create the data stream of an amendment pulse as shown in drawing 3 in the initialization processing after turning on the drive power source of the drive control unit 1.
[0025] (Locational error amendment actuation) Next, amendment of the locational error which is the description part of the drive control action of the actuator 2 by the drive control device 1 is explained. It asks for the amendment pulse number of the motor revolving shaft 4 expressed by the feedback pulse concerned which corresponds from the error correction data 10 absolutely based on a location, the amendment pulse number is added to a feedback pulse (8) in the rotation location amendment information creation section 13, and it returns to the feedback pulse (8) of the location detection from a position transducer 6 by making an addition result into a location feedback pulse (12) at the feedback-control section 15. In the feedback control section 15, based on the location feedback pulse (12) concerned, feedback control of the actuator 2 is carried out so that it may become the target position directed using the location command information 14 that it is inputted.
[0026] In addition, in this example, it is made to carry out storage maintenance of the error correction data 10 at the drive control unit 1. You may make it make the position transducer 6 of an actuator 2 instead carry out storage maintenance of the error correction data 10. In this case, what is necessary is just to constitute in initialization processing immediately after supplying a power source to the drive control device 1, so that the error correction data 10 currently held at the position transducer 6 of an actuator may be downloaded to the drive control-device 1 side.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline block diagram showing an example of the drive control device of the actuator which applied this invention.
[Drawing 2] It is a table for explaining the creation approach of the error correction data used for amendment of the locational error kicked to the drive control device of drawing 1 .
[Drawing 3] It is the table showing the correspondence table of the created error correction data.
[Description of Notations]
1 Drive Control Unit
2 Actuator
3 Motor
4 Motor Revolving Shaft
5 Wave-Motion Gear Reducer
6 Position Transducer
7 Output Shaft of Wave-Motion Gear Reducer (Actuator Output Shaft)
8 Rotation Positional Information
10 Error Correction Data
11 Error Correction Data Storage Section
12 Position Feedback Information
13 Rotation Location Amendment Data Origination Section
14 Location Command Information
15 Feedback Control Section

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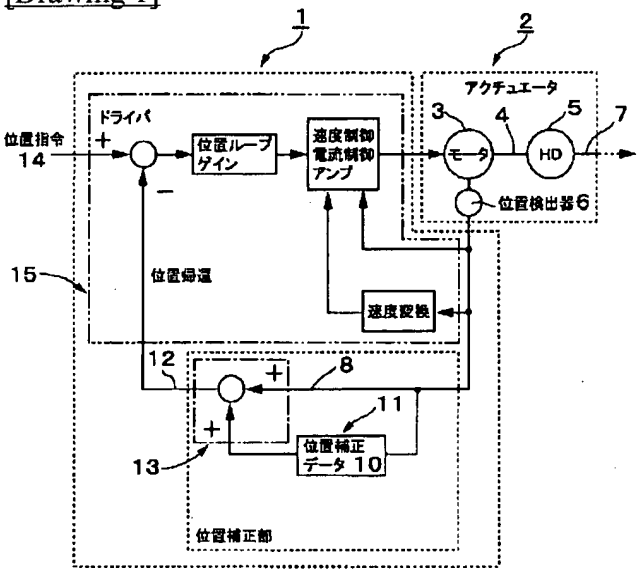
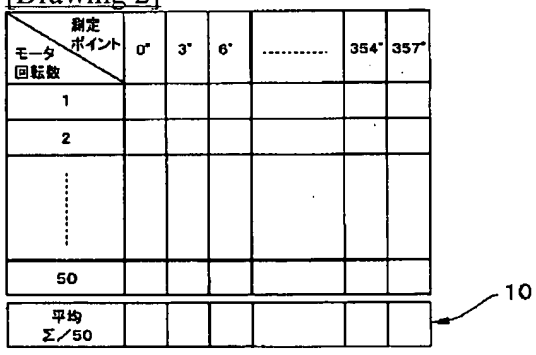
DRAWINGS

[Drawing 1]



システム構成

[Drawing 2]



[Drawing 3]

誤差補正データ

回転位置	補正パルス数
358.5° ～ 1.4°	------
1.5° ～ 4.5°	------
4.5° ～ 6.0°	------
⋮	⋮
357° ～ 358.4°	—

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